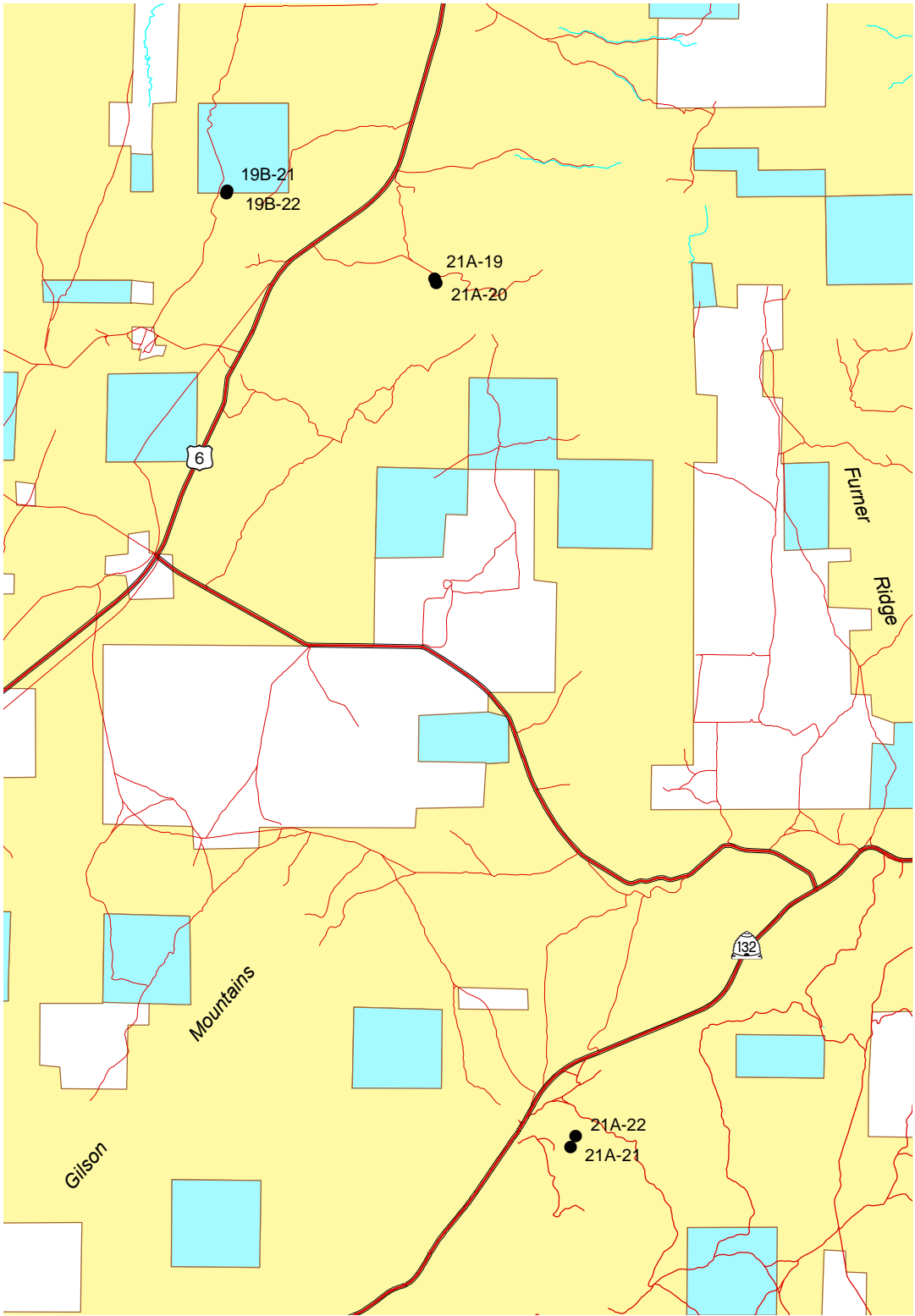


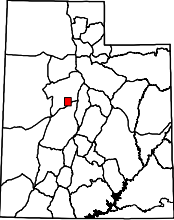
# Burn Rehab Treatment Area



Map Scale 1:115,249 (1 inch = 1.8 miles)

Map Location

- BLM
- State of Utah
- Private Land
- Water Body
- Major Road
- Minor Road
- Water Course



## LEAMINGTON BURN COMPLEX SPECIAL STUDIES

### Introduction

In 1996, Utah experienced one of its most active, extensive, and devastating fire seasons in history. In Millard and Juab Counties alone, some 250,000 acres (101,171 ha) burned. The Leamington complex was the largest burned area, covering approximately 138,340 acres (55,984 ha) of mostly pinyon-juniper woodland. Rehabilitation efforts began in the fall of 1996, which included drilling the more accessible low-lying areas, with the remainder being aurally seeded and one-way chained to cover the seed. On the Leamington complex, about 6,100 acres (2,469 ha) were treated with a rangeland drill, 10,736 acres (4,345 ha) were aurally seeded and one-way chained, and 8,308 acres (3,362 ha) were aurally seeded only. Aurally seeding and then chaining is an effective method of breaking up burned trees, which provide valuable surface litter to help protect the soil from erosion. Chaining also enhances seed establishment by covering the seed with soil and litter. This practice was stopped temporarily because of concerns voiced by environmental and Native American groups with regard to archeological resources in the burned areas, even though an archeological survey had been completed. In 1997, two studies named Leamington Burn and Chain (21A-21) and Leamington Burn (21A-22) were established. One was placed in a burned and seeded area, and the other in an area that had been burned, seeded, then chained one-way. Additional pairs of studies were established in 1998; two near Jericho (19B-21 and 19B-22), and two near Paul Bunyan (21A-19 and 21A-20) to monitor the effects of treatments to those at the Leamington sites. The purpose of these studies was to monitor and compare the recovery of these areas following rehabilitation using seeding alone and seeding and chaining.

### Seed Lists

#### **Jericho State Section (19B-21)**

##### Aerial Seed Mix

Species	Pounds per acre	Kg per ha
High Crest ( <i>Agropyron cristatum</i> )	5	5.6
Intermediate Wheatgrass ( <i>Agropyron intermedium</i> )	3	3.4
Alfalfa ( <i>Medicago sativa</i> )	1	1.1
Yellow Sweet Clover ( <i>Melilotus officinalis</i> )	0.5	0.6

#### **Jericho BLM Section (19B-22)**

##### Aerial Seed Mix

Species	Pounds per acre	Kg per ha
High Crest ( <i>Agropyron cristatum</i> )	3.1	3.5
Rye ( <i>Elymus junceus</i> )	2.1	2.4
Tall wheatgrass ( <i>Agropyron elongatum</i> )	2.0	2.3
Smooth Brome ( <i>Bromus inermis</i> )	1.9	2.1

##### Dribbler Seed Mix

Fourwing saltbush ( <i>Atriplex canescens</i> )	1.0	1.1
---	-----	-----

**Paul Bunyan Burn (21A-19) and Paul Bunyan Burn and Chain (21A-20)**

## Aerial Mix

Species	Pounds of Seed	Pounds per acre
Hycrest crested wheatgrass ( <i>Agropyron cristatum</i> )	15,100	4.0
Russian wildrye ( <i>Elymus junceus</i> )	11,350	3.0
Elongated wheatgrass ( <i>Agropyron elongatum</i> )	7,500	2.0

## Dribbler Mix

Fourwing saltbush ( <i>Atriplex canescens</i> )	3,800	1.0
---	-------	-----

**Leamington Burn (21A-22) and Leamington Burn and Chain (21A-21)**

## Aerial Mix

Species	Pounds of seed	Pounds per acre
Hycrest crested wheatgrass ( <i>Agropyron cristatum</i> )	12,450	3.3
Russian wildrye ( <i>Elymus junceus</i> )	12,450	3.3
Elongated wheatgrass ( <i>Agropyron elongatum</i> )	8,300	2.2
Great Basin wildrye ( <i>Elymus cinereus</i> )	2,000	0.53
Smooth brome ( <i>Bromus inermis</i> )	600	0.16
Alfalfa ( <i>Medicago sativa</i> )	1,200	0.32
Small burnet ( <i>Sanguisorba minor</i> )	500	0.13

## Dribbler Mix

Fourwing saltbush ( <i>Atriplex canescens</i> )	3,700	1.0
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### Trend Study 21A-19-07

Study site name: Paul Bunyan Burn .

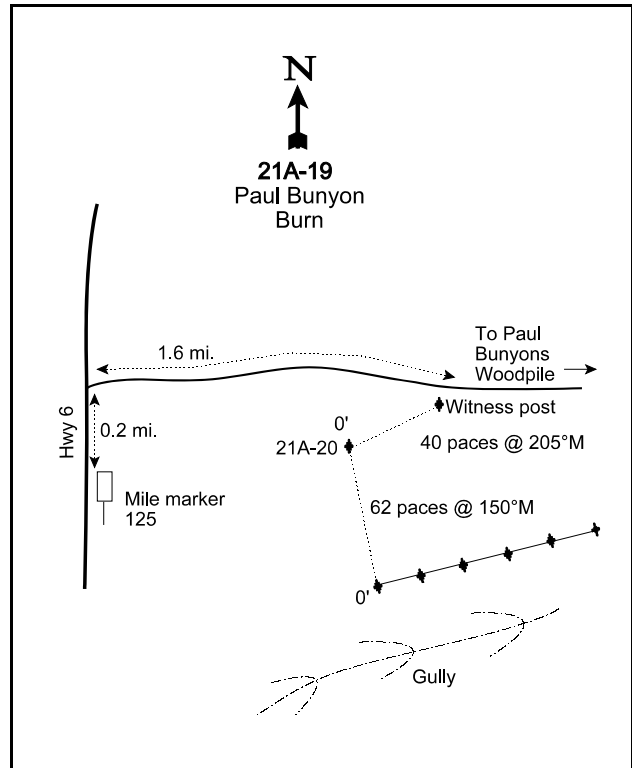
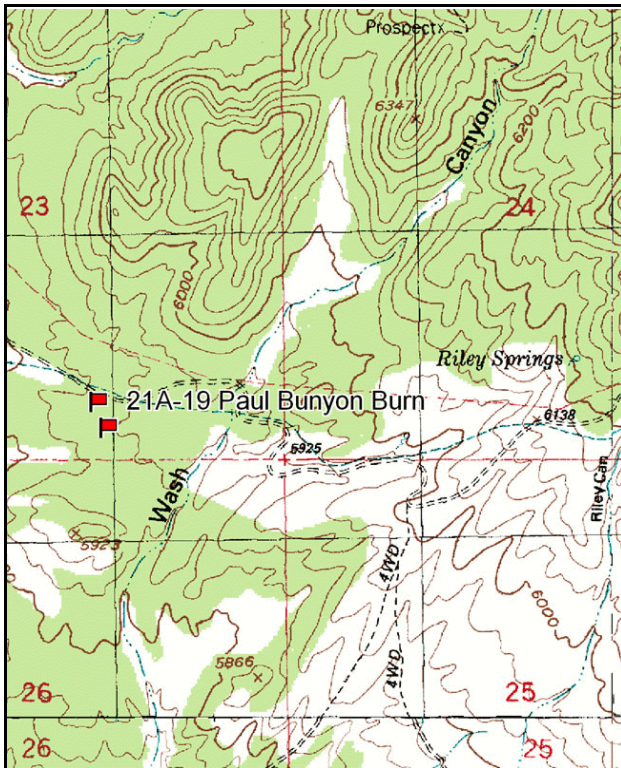
Vegetation type: Burn and Seeded .

Compass bearing: frequency baseline 68 degrees magnetic.

Frequency belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95ft). Rebar: belt 2 on 4ft.

### LOCATION DESCRIPTION

From Hwy 6 go 0.2 miles north of mile marker 125. Turn right (east) heading toward the Paul Bunyan Woodpile. Drive 1.6 miles to a four foot tall witness post on the right side of the road. The 0-foot stake for study 19B-20 is 40 paces at 205degrees magnetic. The 0-foot stake for 19B-19 is 62 paces at 150 degrees magnetic from the other sites' 0-foot stake. The site is marked by short green fenceposts. The 0-foot stake is marked by browse tag # 66.



Map Name: McIntyre

Diagrammatic Sketch

Township 12S, Range 3W, Section 23

GPS: NAD 83, UTM 12S 401897 E 4401539 N

## DISCUSSION

### Paul Bunyan Burn - Trend Study No. 21A-19

#### Study Information

This study was established in 1998 to monitor a burned and seeded pinyon-juniper woodland [elevation: 5,900 feet (1,798 m), slope: 8%-10%, aspect: southwest]. This study and the adjacent Paul Bunyan Burn and Chain study (21A-20) were part of the extensive Leamington burn complex which affected approximately 138,340 acres (55,986 ha) of mostly pinyon-juniper rangelands. Rehabilitation efforts were started during the fall of 1996, and included drilling, chaining, and seeding. This study samples an area that was aerially seeded, but was not chained. It is the comparison to study 21A-20, which was chained. Wildlife use this area sparingly and deer and elk pellets have been infrequent in all readings. Deer use was estimated at 7 days use/acre (18 ddu/ha) in 2002. Rabbit pellet quadrat frequency has increased from 11% in 1998 to 80% in 2007. Cattle pats had a 2% quadrat frequency in 2007, but grazing appeared to be light.

#### Soil

The soil is classified within the Jericho series (USDA-NRCS 2007). The soils in this series are shallow over a duripan layer and are well-drained. They formed in alluvium derived mainly from igneous rocks. The soil texture is a sandy clay loam and the pH is neutral (7.0). Relative combined rock and pavement cover was high in 1998 at 32%, then decreased to 16% by 1999 and has remained relatively stable at less than 20%. The soil is rocky at soil depths greater than 4 inches (10.2 cm). Relative bare ground cover decreased from 35% in 1998 to 20% in 2002, then increased to 26% by 2007. Relative combined vegetation and litter cover was 33% in 1998 and approximately 60% in 1999-2007. Some erosion is evident in the form of pedestalling and soil movement, but the soil erosion condition was classified as stable in 2002 and 2007.

#### Browse

Prior to the fire in 1996, the study was dominated by Utah juniper (*Juniperus osteosperma*). Point-centered quarter data collected on dead trees estimated a density of 331 trees/acre (818 trees/ha) in 1998. Following the fire, the browse component was reduced to almost nothing. White rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *albicaulis*) was the most abundant shrub in 2007, with a density of 180 plants/acre (445 plants/ha). These plants were heavily browsed by rabbits. Fourwing saltbush (*Atriplex canescens*), Stansbury cliffrose (*Cowania mexicana* ssp. *stansburiana*), green ephedra (*Ephedra viridis*), and bitterbrush (*Purshia tridentata*) are also scattered throughout the study in very low densities. In 2007, fourwing saltbush canopy cover was approximately the same as that for rabbitbrush.

#### Herbaceous Understory

Perennial grasses are the key vegetative component in the community. Because the study was seeded but not chained, perennial grasses have been slow to establish. Average perennial grass cover was 4% in 1998 and 5% in 1999, then increased substantially to 12% in 2002 and 2007. Seeded species, such as crested wheatgrass (*Agropyron cristatum*) and Russian wildrye (*Elymus junceus*), are the most abundant perennial species. Crested wheatgrass provided 48% of the total grass cover in 2002 and 61% in 2007. Native species occur less frequently, and include bottlebrush squirreltail (*Sitanion hystrix*), Indian ricegrass (*Oryzopsis hymenoides*), and bluebunch wheatgrass (*Agropyron spicatum*). Cheatgrass (*Bromus tectorum*) was the most abundant grass in 1998 and 1999, providing 76% and 82% of the total grass cover, respectively. Average cheatgrass cover declined from 21% in 1999 to 4% in 2002 and 2% in 2007. Grasses have been vigorous, with some of the seeded species growing to 3 feet (0.9 m) in height.

No forbs were included in the seed mix due to a plan to spray herbicide in the future for noxious weed control. Average forb cover increased from 3%-4% in 1998 and 1999 to 18% in 2007. However, annual species provided 98% of the total forb cover in 2002 and 2007. As annual forb cover increased, perennial forb cover decreased from 3% in 1998 to less than 1% in 2007. Prickly lettuce (*Lactuca serriola*) was the most abundant

forb in 1998 and 1999, while desert alyssum (*Alyssum desertorum*) provided 60% of the total forb cover in 2002 and 77% in 2007. Tumblemustard (*Sisymbrium altissimum*) is also common. Musk thistle (*Carduus nutans*), a noxious weed, was sampled in one quadrat in 1998. Mormon crickets (*Anabrus simplex*) were noted to have utilized forbs in 2002.

#### 1999 TREND ASSESSMENT

The trend for browse is stable. No key browse species were sampled within the density strips, which was a decreased from 40 fourwing saltbush plants/acre (99 plants/ha) in 1998. The trend for grass is stable. The sum of nested frequency for perennial grasses increased 11%. Average perennial grass cover increased from 4% to 5%, however, average cheatgrass cover increased dramatically from 13% to 21%. Cheatgrass also increased significantly in nested frequency, and its quadrat frequency increased from 79% to 96%. The trend for forbs is slightly up. The sum of nested frequency for perennial forbs changed little. Musk thistle was sampled in 1998, but was not sampled in 1999. The Desirable Components Index (DCI) rating in 1998 was very poor due to the lack of browse, low perennial grass cover, high annual grass cover, and the presence of a noxious weed. The DCI rating remained very poor in 1999.

1998 winter range condition (DCI) - very poor (3) Low potential scale

1999 winter range condition (DCI) - very poor (-4) Low potential scale

browse - stable (0)

grass - stable (0)

forb - slightly up (+1)

#### 2002 TREND ASSESSMENT

The trend for browse is stable. No key browse species were sampled. The trend for grass is up. The sum of nested frequency for perennial grasses increased 31%. Average perennial grass cover increased from 5% to 12%, while average cheatgrass cover declined from 21% to 4%. Cheatgrass also decreased significantly in nested frequency, and its quadrat frequency decreased to 66%. The trend for forbs is down. The sum of nested frequency for perennial forbs decreased 66%, and perennial forb cover was almost nonexistent. Annual forb cover increased from 1% to 8%, mainly due to significant increases in the nested frequencies of alyssum, tumblemustard, and Russian thistle (*Salsola iberica*). The DCI rating increased to poor due to the increase in perennial grass cover and the decrease in annual grass cover.

winter range condition (DCI) - poor (21) Low potential scale

browse - stable (0)

grass - up (+2)

forb - down (-2)

#### 2007 TREND ASSESSMENT

The trend for browse is stable. No key browse species were sampled within the density strips. The trend for grass is up. The sum of nested frequency for perennial grasses increased almost 100%. Crested wheatgrass and squirreltail increased significantly in nested frequency. Cheatgrass remained stable in nested frequency and quadrat frequency, and cover continued to decrease from 4% to 2%. The trend for forbs is stable. The sum of nested frequency for perennial forbs changed little and average cover remained below 1%. Annual forb cover increased from 8% to 17%. Alyssum increased significantly in nested frequency. The DCI rating increased to poor-fair due to the decrease in cheatgrass cover.

winter range condition (DCI) - poor-fair (24) Low potential scale

browse - stable (0)

grass - up (+2)

forb - stable (0)

HERBACEOUS TRENDS --

Management unit 21A, Study no: 19

T y p e	Species	Nested Frequency				Average Cover %			
		'98	'99	'02	'07	'98	'99	'02	'07
G	Agropyron cristatum	<sub>a</sub> 58	<sub>ab</sub> 74	<sub>b</sub> 93	<sub>c</sub> 199	1.64	2.61	7.23	8.44
G	Agropyron dasystachyum	-	-	-	2	-	-	-	.00
G	Agropyron elongatum	<sub>a</sub> 7	<sub>a</sub> 7	<sub>a</sub> 9	<sub>a</sub> 7	.33	.19	.61	.59
G	Agropyron spicatum	-	<sub>a</sub> 3	-	<sub>a</sub> 2	-	.00	-	.15
G	Bromus inermis	-	-	-	16	.00	.03	-	.22
G	Bromus japonicus (a)	-	-	<sub>a</sub> 4	<sub>a</sub> 1	-	-	.03	.00
G	Bromus tectorum (a)	<sub>a</sub> 268	<sub>b</sub> 395	<sub>a</sub> 227	<sub>a</sub> 210	12.52	20.85	3.51	1.86
G	Elymus junceus	<sub>a</sub> 27	<sub>a</sub> 22	<sub>a</sub> 26	<sub>a</sub> 29	1.49	1.32	2.77	1.75
G	Oryzopsis hymenoides	<sub>a</sub> 4	<sub>a</sub> 3	<sub>a</sub> 6	<sub>a</sub> 4	.21	.45	.74	.24
G	Sitanion hystrix	<sub>a</sub> 2	<sub>a</sub> -	<sub>a</sub> 9	<sub>b</sub> 26	.38	.00	.23	.54
Total for Annual Grasses		268	395	231	211	12.52	20.85	3.54	1.87
Total for Perennial Grasses		98	109	143	285	4.06	4.62	11.60	11.95
Total for Grasses		366	504	374	496	16.58	25.48	15.14	13.82
F	Alyssum alyssoides (a)	-	-	-	7	-	-	-	.03
F	Alyssum desertorum (a)	<sub>a</sub> 45	<sub>a</sub> 65	<sub>b</sub> 290	<sub>c</sub> 364	.26	.20	4.65	13.47
F	Argemone munita	<sub>a</sub> -	<sub>a</sub> -	-	-	.30	.03	-	-
F	Astragalus calycosus	-	-	-	4	-	-	-	.19
F	Astragalus eurekaensis	-	-	-	2	-	-	-	.00
F	Astragalus sp.	<sub>a</sub> 3	-	<sub>a</sub> 6	-	.01	-	.04	-
F	Camelina microcarpa (a)	-	<sub>a</sub> 8	-	<sub>a</sub> 12	-	.30	-	.03
F	Carduus nutans (a)	2	-	-	-	.00	-	-	-
F	Chaenactis douglasii	<sub>a</sub> 11	-	<sub>a</sub> 3	<sub>a</sub> 4	.24	-	.00	.01
F	Chenopodium sp. (a)	-	-	1	-	-	-	.00	-
F	Cruciferae	10	-	-	-	.24	-	-	-
F	Cryptantha sp.	-	-	5	-	-	-	.03	-
F	Descurainia pinnata (a)	<sub>a</sub> 8	-	-	<sub>b</sub> 32	.18	-	-	.13
F	Eriogonum cernuum (a)	<sub>a</sub> 16	<sub>a</sub> 8	-	-	.23	.06	-	-
F	Gilia sp. (a)	-	<sub>a</sub> 2	<sub>a</sub> 1	<sub>a</sub> 6	-	.00	.00	.01
F	Helianthus annuus (a)	-	2	-	-	-	.00	-	-
F	Lactuca serriola	<sub>b</sub> 68	<sub>b</sub> 86	-	<sub>a</sub> 20	2.51	1.20	-	.14
F	Lesquerella sp.	<sub>a</sub> -	-	<sub>a</sub> 3	<sub>a</sub> 2	.00	-	.00	.03
F	Machaeranthera canescens	-	-	1	-	-	-	.00	-
F	Nicotiana attenuata (a)	-	-	-	-	.00	-	-	-
F	Phlox hoodii	-	-	3	-	-	-	.00	-

Type	Species	Nested Frequency				Average Cover %			
		'98	'99	'02	'07	'98	'99	'02	'07
F	Phlox longifolia	-	-	3	-	-	-	.01	-
F	Salsola iberica (a)	<sub>a</sub> 1	<sub>a</sub> 10	<sub>b</sub> 43	-	.01	.33	.78	-
F	Senecio multilobatus	-	-	5	-	-	-	.04	-
F	Sisymbrium altissimum (a)	<sub>a</sub> 4	<sub>a</sub> 22	<sub>b</sub> 86	<sub>b</sub> 100	.31	.49	2.20	3.42
F	Tragopogon dubius	-	-	-	2	-	-	-	.01
F	Zigadenus paniculatus	-	-	-	2	-	-	-	.00
Total for Annual Forbs		76	117	421	521	1.02	1.40	7.65	17.10
Total for Perennial Forbs		92	86	29	36	3.32	1.23	0.14	0.39
Total for Forbs		168	203	450	557	4.34	2.64	7.80	17.50

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS --

Management unit 21A, Study no: 19

Type	Species	Strip Frequency				Average Cover %			
		'98	'99	'02	'07	'98	'99	'02	'07
B	Atriplex canescens	2	0	0	1	.03	-	-	-
B	Chrysothamnus nauseosus albicaulis	0	0	0	8	-	-	-	.30
Total for Browse		2	0	0	9	0.03	0	0	0.30

#### CANOPY COVER, LINE INTERCEPT --

Management unit 21A, Study no: 19

Species	Percent Cover	
	'02	'07
Atriplex canescens	-	.20
Chrysothamnus nauseosus albicaulis	-	.28



# BASIC COVER --

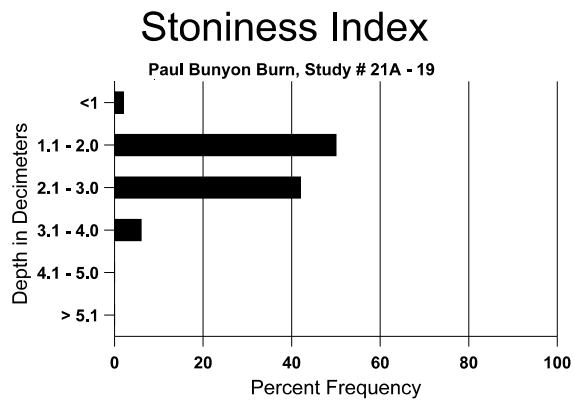
Management unit 21A, Study no: 19

Cover Type	Average Cover %			
	'98	'99	'02	'07
Vegetation	21.67	30.56	24.22	31.54
Rock	3.33	3.46	2.35	2.05
Pavement	32.45	14.92	19.34	16.32
Litter	15.95	35.60	45.85	34.27
Cryptogams	0	0	.38	.14
Bare Ground	39.84	28.43	23.67	29.82

# SOIL ANALYSIS DATA --

Herd Unit 21A, Study no: 19, Paul Bunyan Burn

Effective rooting depth (in)	Temp °F (depth)	pH	Sandy clay loam			%OM	ppm P	ppm K	dS/m
			%sand	%silt	%clay				
14.0	70.0 (15.5)	7.0	48.7	24.7	26.6	2.7	11.6	115.2	0.6



# PELLET GROUP DATA --

Management unit 21A, Study no: 19

Type	Quadrat Frequency			
	'98	'99	'02	'07
Rabbit	11	13	22	80
Elk	-	4	-	-
Deer	1	3	6	-
Cattle	-	-	-	2

Days use per acre (ha)	
'02	'07
-	-
-	-
7 (18)	-
1 (2)	-

BROWSE CHARACTERISTICS --  
Management unit 21A, Study no: 19

		Age class distribution (plants per acre)					Utilization					
Y e a r	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
<i>Artemisia tridentata wyomingensis</i>												
98	0	-	-	-	-	20	0	0	-	-	0	-/-
99	0	-	-	-	-	-	0	0	-	-	0	-/-
02	0	-	-	-	-	-	0	0	-	-	0	-/-
07	0	-	-	-	-	-	0	0	-	-	0	-/-
<i>Atriplex canescens</i>												
98	40	-	20	20	-	-	0	50	-	-	0	-/-
99	0	-	-	-	-	20	0	0	-	-	0	-/-
02	0	-	-	-	-	-	0	0	-	-	0	44/62
07	20	-	-	20	-	-	0	0	-	-	0	66/84
<i>Chrysothamnus nauseosus albicaulis</i>												
98	0	-	-	-	-	-	0	0	-	-	0	-/-
99	0	-	-	-	-	-	0	0	-	-	0	-/-
02	0	-	-	-	-	-	0	0	-	-	0	42/66
07	180	40	60	120	-	-	78	22	-	-	0	19/26
<i>Cowania mexicana stansburiana</i>												
98	0	-	-	-	-	-	0	0	-	-	0	-/-
99	0	-	-	-	-	-	0	0	-	-	0	-/-
02	0	-	-	-	-	-	0	0	-	-	0	16/18
07	0	-	-	-	-	-	0	0	-	-	0	38/55
<i>Ephedra viridis</i>												
98	0	-	-	-	-	-	0	0	-	-	0	-/-
99	0	-	-	-	-	-	0	0	-	-	0	-/-
02	0	-	-	-	-	-	0	0	-	-	0	27/44
07	0	-	-	-	-	-	0	0	-	-	0	37/55
<i>Juniperus osteosperma</i>												
98	0	-	-	-	-	380	0	0	-	-	0	-/-
99	0	-	-	-	-	340	0	0	-	-	0	-/-
02	0	-	-	-	-	-	0	0	-	-	0	-/-
07	0	-	-	-	-	100	0	0	-	-	0	-/-

		Age class distribution (plants per acre)					Utilization					
Y e a r	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
<i>Purshia tridentata</i>												
98	0	-	-	-	-	-	0	0	-	-	0	-/-
99	0	-	-	-	-	-	0	0	-	-	0	-/-
02	0	-	-	-	-	-	0	0	-	-	0	13/22
07	0	-	-	-	-	-	0	0	-	-	0	-/-

Trend Study 21A-20-07

Study site name: Paul Bunyan Burn and Chain.

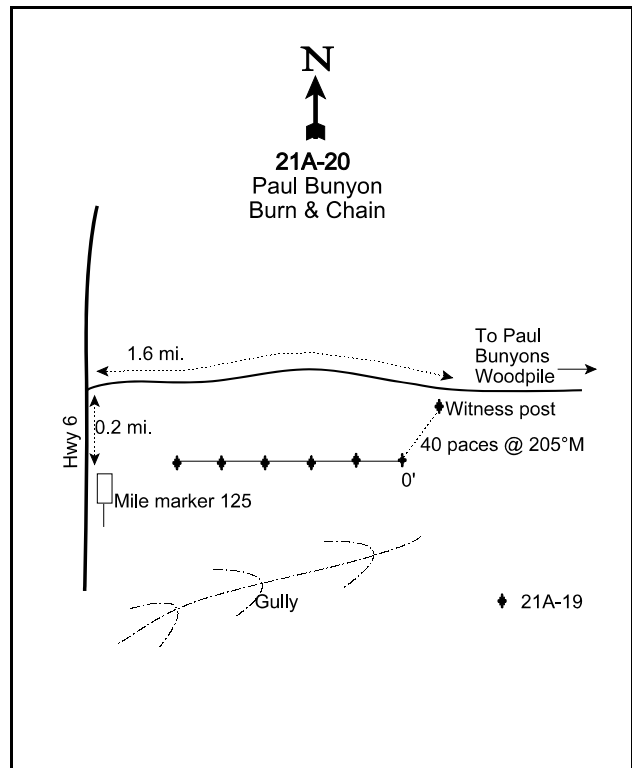
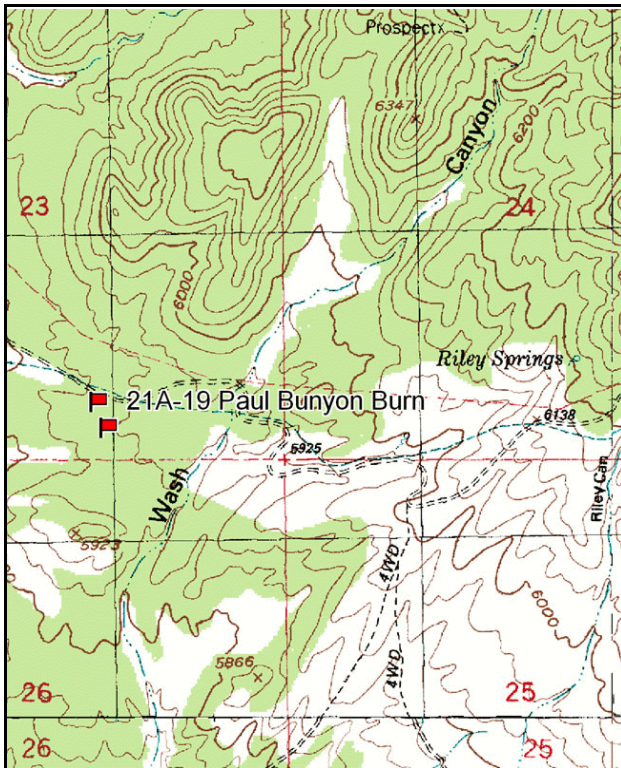
Vegetation type: Burn and Seeded.

Compass bearing: frequency baseline 268 degrees magnetic.

Frequency belt placement: line 1 (11ft), line 2 (34ft), line 3 (59ft), line 4 (71ft), line 5 (95ft).

LOCATION DESCRIPTION

From Hwy 6 go 0.2 miles north of mile marker 125. Turn right heading toward the Paul Bunyan Woodpile. Drive 1.6 miles to a four foot tall witness post on the right side of the road. The 0-foot stake for this study is 40 paces at 205 degrees magnetic from the witness post. The site is marked by short green fenceposts. The 0-foot stake is marked by browse tag #74.



Map Name: McIntyre

Diagrammatic Sketch

Township 12S, Range 3W, Section 23

GPS: NAD 83, UTM 12S 401867 E 4401625 N

## DISCUSSION

### Paul Bunyan Burn and Chain - Trend Study No. 21A-20

#### Study Information

This study was placed northwest of the Paul Bunyan Burn study (21A-19) [elevation: 5,900 feet (1,798 m), slope: 5%, aspect: west]. Seed was applied aerially and the area was chained one-way with an Ely chain to help cover the seed and enhance establishment of the seeded species. A seed dribbler was used to apply fourwing saltbush (*Atriplex canescens*) seed during the chaining. Due to low browse cover, the area is of very little use for wintering big game. Elk pellet quadrat frequency was 8% in 1999. Deer pellet quadrat frequency was 3% in 2002 and 2% in 2007. No deer or elk pellets were sampled along the pellet group transect in 2002 or 2007. Rabbit pellet quadrat frequency has increased from 3% in 1998 to 76% in 2007.

#### Soil

The soil is classified within the Jericho series (USDA-NRCS 2007). The soils in this series are shallow over a duripan layer and are well-drained. They formed in alluvium derived mainly from igneous rocks. The soil texture is a sandy clay loam, and the pH is neutral (7.0). Soil phosphorus is marginal at 8.9 ppm (Tiedemann and Lopez 2004). Relative combined rock and pavement cover has remained relatively stable at 17%-21% in all sample years. Relative bare ground cover has decreased from 47% in 1998 to 31% in 1999 and 26% in 2002 and 2007. Relative combined vegetation and litter cover has steadily increased from 33% in 1998 to 56% in 2007. Some erosion is evident in the form of pedestalling and soil movement, but the soil erosion condition was classified as stable in 2002 and 2007.

#### Browse

Seeded fourwing saltbush provides the majority of the preferred browse. Its density has declined since the seeding, from 280 plants/acre (692 plants/ha) in 1998 to 40 plants/acre (99 plants/ha) in 2007. Average cover has been less than 1% in all sample years and, like density, has steadily decreased. Young recruitment was high at 50% of the population in 1998, but decreased to 25% in 1999, and no young plants were sampled in 2002 or 2007. Decadence has increased from 8% of the population in 1999 to 63% in 2002 and 50% in 2007. The density of dead plants increased from 40 plants/acre (99 plants/ha) in 2002 to 180 plants/acre (445 plants/ha) in 2007. All of the plants were vigorous in 1998 and 1999, but all of the decadent plants in 2002 and 2007 displayed poor vigor and were classified as dying. Use was light-moderate in 2002 and heavy in 2007.

Other palatable browse species are present at low densities. These include Stansbury cliffrose (*Cowania mexicana* ssp. *stansburiana*), antelope bitterbrush (*Purshia tridentata*), green ephedra (*Ephedra viridis*), and white rubber rabbitbrush (*Chrysothamnus nauseosus* ssp. *albicaulis*).

#### Herbaceous Understory

Perennial grasses dominate the understory. The most abundant species are seeded perennials, including crested wheatgrass (*Agropyron cristatum*), Russian wildrye (*Elymus junceus*), and elongated wheatgrass (*Agropyron elongatum*). These species have provided 64%-86% of the total grass cover since 1998. Native perennial species, such as bluebunch wheatgrass (*Agropyron spicatum*), Indian ricegrass (*Oryzopsis hymenoides*), and bottlebrush squirreltail (*Sitanion hystrix*), have been rare. Perennial grass cover was 15% in 1998, 12% in 1999, 20% in 2002, and 19% in 2007. Average cheatgrass (*Bromus tectorum*) cover declined from 5% in 1999 to 2% in 2002 and 2007. Cheatgrass provided 23% of the total grass cover in 1998, 31% in 1999, and approximately 10% in 2002 and 2007.

Average forb cover was approximately 1% in all sample years until 2007, when cover increased to 8%. However, this increase was due to a significant increase in desert alyssum (*Alyssum desertorum*) cover. Alyssum provided 37% of the total forb cover in 2002 and 94% in 2007. Other abundant forb species have

included prickly lettuce (*Lactuca serriola*) and tumbledustard (*Sisymbrium altissimum*). Musk thistle (*Carduus nutans*), a noxious weed, was present in 2007, but was not abundant and was not sampled in any quadrats.

#### 1999 TREND ASSESSMENT

The trend for browse is slightly down. Fourwing saltbush density decreased from 280 plants/acre (692 plants/ha) to 240 plants/acre (593 plants/ha). Young recruitment decreased from 50% of the population to 25%, and decadence increased from 0% to 8% of the population. Vigor remained excellent, and use remained light. The trend for grass is slightly down. The sum of nested frequency for perennial grasses decreased 16%. Russian wildrye decreased significantly in nested frequency. Average perennial grass cover decreased from 15% to 12%, while average cheatgrass cover increased slightly from 4% to 5%. Cheatgrass nested frequency did not change significantly, and its quadrat frequency decreased from 84% to 76%. The trend for forbs is stable. The sum of nested frequency for perennial forbs decreased 10% and total forb cover remained below 1%. Tumbledustard decreased significantly in nested frequency. The Desirable Components Index (DCI) was rated as fair in 1998 due to very low browse and perennial forb cover, but high perennial grass cover. The DCI rating decreased to poor in 1999 due to the decrease in perennial grass cover.

1998 winter range condition (DCI) - fair (28) Low potential scale

1999 winter range condition (DCI) - poor (21) Low potential scale

browse - slightly down (-1)      grass - slightly down (-1)      forb - stable (0)

#### 2002 TREND ASSESSMENT

The trend for browse is down. Fourwing saltbush density decreased from 240 plants/acre (593 plants/ha) to 160 plants/acre (395 plants/ha). Decadence increased from 8% of the population to 63% and no young plants were sampled. All of the decadent plants displayed poor vigor and were classified as dying. Use increased slightly, with 13% of the sampled plants showing moderate hedging. The trend for grass is slightly up. The sum of nested frequency for perennial grasses increased 10% and cover increased from 12% to 20%. Cheatgrass decreased significantly in nested frequency, and quadrat frequency decreased from 76% to 43%. Average cheatgrass cover decreased from 5% to 2%. The trend for forbs is slightly down. The sum of nested frequency for perennial forbs decreased slightly. Alyssum increased significantly in nested frequency and prickly lettuce decreased significantly in nested frequency. The DCI rating improved to fair due to the increase in perennial grass cover and the decrease in annual grass cover.

winter range condition (DCI) - fair (30) Low potential scale

browse - down (-2)      grass - slightly up (+1)      forb - slightly down (-1)

#### 2007 TREND ASSESSMENT

The trend for browse is down. Fourwing saltbush density decreased 75%, from 160 plants/acre (395 plants/ha) to 40 plants/acre (99 plants/ha). Decadence decreased slightly, but was still high at 50% of the population. The density of dead plants increased from 40 plants/acre (99 plants/ha) to 180 plants/acre (445 plants/ha). No seedling or young plants were sampled. Vigor was poor on half of the sampled plants. Use increased from mostly light to heavy. The trend for grass is up. The sum of nested frequency for perennial grasses increased 36%. Russian wildrye increased significantly in nested frequency. Cheatgrass nested frequency and cover remained stable, while quadrat frequency increased from 43% to 60%. The trend for forbs is stable. The sum of nested frequency for perennial forbs changed little. Alyssum increased significantly in nested frequency and increased in cover from less than 1% to 7%. The DCI rating remained fair.

winter range condition (DCI) - fair (29) Low potential scale

browse - down (-2)      grass - up (+2)      forb - stable (0)

HERBACEOUS TRENDS --  
Management unit 21A, Study no: 20

Type	Species	Nested Frequency				Average Cover %			
		'98	'99	'02	'07	'98	'99	'02	'07
G	Agropyron cristatum	<sub>a</sub> 133	<sub>a</sub> 139	<sub>ab</sub> 158	<sub>b</sub> 193	7.22	8.46	12.64	10.59
G	Agropyron elongatum	<sub>a</sub> 52	<sub>a</sub> 44	<sub>a</sub> 47	<sub>a</sub> 36	2.69	2.12	2.34	2.20
G	Agropyron spicatum	<sub>a</sub> 9	<sub>a</sub> 13	<sub>a</sub> 14	<sub>a</sub> 17	.56	.78	1.44	.66
G	Bromus japonicus (a)	-	-	-	1	-	-	-	.00
G	Bromus tectorum (a)	<sub>b</sub> 270	<sub>b</sub> 265	<sub>a</sub> 124	<sub>a</sub> 166	4.39	5.38	2.13	2.21
G	Elymus junceus	<sub>b</sub> 78	<sub>a</sub> 24	<sub>a</sub> 33	<sub>b</sub> 78	3.87	.45	3.65	5.00
G	Oryzopsis hymenoides	-	-	<sub>a</sub> 2	<sub>a</sub> 6	-	-	.06	.01
G	Poa secunda	-	7	-	-	-	.02	-	-
G	Sitanion hystrix	<sub>a</sub> 4	<sub>a</sub> 4	-	<sub>b</sub> 15	.21	.01	.00	.13
Total for Annual Grasses		270	265	124	167	4.39	5.38	2.13	2.22
Total for Perennial Grasses		276	231	254	345	14.56	11.86	20.16	18.61
Total for Grasses		546	496	378	512	18.95	17.24	22.29	20.82
F	Alyssum desertorum (a)	<sub>a</sub> 13	<sub>a</sub> 27	<sub>b</sub> 122	<sub>c</sub> 308	.19	.10	.38	7.09
F	Antennaria rosea	-	-	3	-	-	-	.00	-
F	Astragalus calycosus	<sub>a</sub> 10	<sub>a</sub> 6	<sub>a</sub> 7	<sub>a</sub> 1	.09	.04	.04	.15
F	Calochortus nuttallii	2	-	-	-	.00	-	-	.00
F	Chaenactis douglasii	<sub>a</sub> 4	-	<sub>a</sub> 1	<sub>a</sub> 2	.03	-	.00	.03
F	Cryptantha sp.	<sub>a</sub> 3	<sub>a</sub> 7	-	<sub>a</sub> 1	.00	.01	-	.00
F	Descurainia pinnata (a)	-	-	-	28	-	-	-	.13
F	Gilia sp. (a)	<sub>a</sub> 3	<sub>a</sub> 1	-	<sub>a</sub> 5	.00	.00	-	.01
F	Lactuca serriola	<sub>b</sub> 35	<sub>b</sub> 49	<sub>a</sub> 11	<sub>a</sub> 12	.58	.36	.19	.03
F	Lesquerella sp.	<sub>a</sub> 1	-	<sub>a</sub> 1	-	.01	-	.00	-
F	Lomatium sp.	<sub>a</sub> 3	-	-	<sub>a</sub> 1	.03	-	-	.00
F	Phlox hoodii	<sub>a</sub> 2	-	<sub>a</sub> 2	-	.00	-	.15	-
F	Phlox longifolia	-	-	<sub>a</sub> 11	<sub>a</sub> 4	-	-	.02	.01
F	Ranunculus testiculatus (a)	-	-	-	8	-	-	-	.01
F	Salsola iberica (a)	<sub>a</sub> 1	<sub>ab</sub> 14	<sub>b</sub> 21	-	.03	.09	.22	-
F	Senecio multilobatus	-	-	-	1	-	-	-	.00
F	Sisymbrium altissimum (a)	<sub>b</sub> 20	<sub>a</sub> 2	-	<sub>b</sub> 22	.32	.07	-	.07
F	Streptanthus cordatus	<sub>a</sub> 9	-	<sub>a</sub> 1	-	.06	-	.01	-
F	Tragopogon dubius	-	-	-	1	-	-	-	.00
F	Zigadenus paniculatus	-	-	-	1	-	-	-	.00
Total for Annual Forbs		37	44	143	371	0.55	0.27	0.60	7.32
Total for Perennial Forbs		69	62	37	24	0.83	0.41	0.42	0.25

T y p e	Species	Nested Frequency				Average Cover %			
		'98	'99	'02	'07	'98	'99	'02	'07
Total for Forbs		106	106	180	395	1.38	0.68	1.03	7.58

Values with different subscript letters are significantly different at alpha = 0.10

#### BROWSE TRENDS --

Management unit 21A, Study no: 20

T y p e	Species	Strip Frequency				Average Cover %			
		'98	'99	'02	'07	'98	'99	'02	'07
B	Atriplex canescens	14	11	8	2	.63	.73	.48	.15
B	Chrysothamnus nauseosus albicaulis	0	0	0	1	-	-	-	-
B	Chrysothamnus viscidiflorus viscidiflorus	1	0	1	1	-	-	-	-
B	Ephedra viridis	0	1	0	0	-	-	-	-
Total for Browse		15	12	9	4	0.63	0.73	0.48	0.15

#### CANOPY COVER, LINE INTERCEPT --

Management unit 21A, Study no: 20

Species	Percent Cover	
	'02	'07
Atriplex canescens	-	.21

#### BASIC COVER --

Management unit 21A, Study no: 20

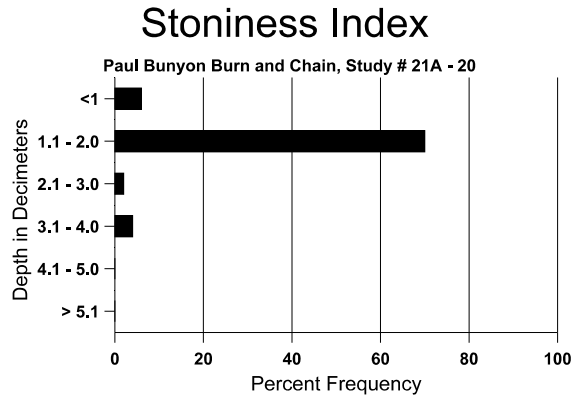
Cover Type	Average Cover %			
	'98	'99	'02	'07
Vegetation	21.46	24.41	24.92	27.09
Rock	4.19	4.36	3.43	2.34
Pavement	17.03	16.23	20.65	16.91
Litter	13.75	26.82	37.07	35.23
Cryptogams	0	0	0	.31
Bare Ground	49.65	32.64	30.29	29.33



# SOIL ANALYSIS DATA --

Herd Unit 21A, Study no: 20, Paul Bunyan Burn and Chain

Effective rooting depth (in)	Temp °F (depth)	pH	Sandy clay loam			%0M	ppm P	ppm K	dS/m
			% sand	% silt	% clay				
13.9	69.0 (14.5)	7.0	48.4	25.1	26.6	2.7	8.9	134.4	.6



# PELLET GROUP DATA --

Management unit 21A, Study no: 20

Type	Quadrat Frequency			
	'98	'99	'02	'07
Rabbit	3	8	13	76
Horse	-	-	1	-
Elk	-	8	-	-
Deer	-	-	3	2

Days use per acre (ha)	
'02	'07
-	-
-	-
-	-
-	-

# BROWSE CHARACTERISTICS --

Management unit 21A, Study no: 20

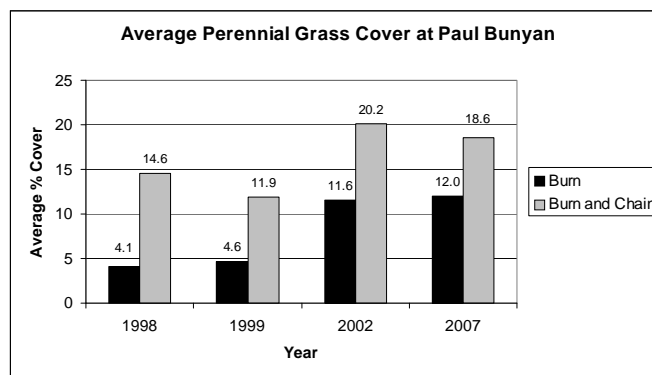
		Age class distribution (plants per acre)					Utilization					
Y	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
<i>Artemisia tridentata wyomingensis</i>												
98	0	-	-	-	-	120	0	0	-	-	0	-/-
99	0	-	-	-	-	-	0	0	-	-	0	-/-
02	0	-	-	-	-	-	0	0	-	-	0	-/-
07	0	-	-	-	-	-	0	0	-	-	0	-/-

		Age class distribution (plants per acre)					Utilization					
Year	Plants per Acre (excluding seedlings)	Seedling	Young	Mature	Decadent	Dead	% moderate	% heavy	% decadent	% dying	% poor vigor	Average Height Crown (in)
<i>Atriplex canescens</i>												
98	280	20	140	140	-	-	0	0	0	-	0	31/35
99	240	20	60	160	20	-	0	0	8	-	0	28/31
02	160	-	-	60	100	40	13	0	63	63	63	36/43
07	40	-	-	20	20	180	0	100	50	50	50	54/66
<i>Chrysothamnus nauseosus albicaulis</i>												
98	0	-	-	-	-	-	0	0	-	-	0	-/-
99	0	-	-	-	-	-	0	0	-	-	0	-/-
02	0	-	-	-	-	-	0	0	-	-	0	33/60
07	20	-	-	20	-	-	0	0	-	-	0	20/39
<i>Chrysothamnus viscidiflorus viscidiflorus</i>												
98	20	-	-	20	-	-	0	0	-	-	0	-/-
99	0	-	-	-	-	-	0	0	-	-	0	-/-
02	20	-	-	20	-	-	0	0	-	-	0	16/31
07	20	-	-	20	-	-	0	0	-	-	0	20/36
<i>Cowania mexicana stansburiana</i>												
98	0	-	-	-	-	-	0	0	-	-	0	-/-
99	0	-	-	-	-	-	0	0	-	-	0	-/-
02	0	-	-	-	-	-	0	0	-	-	0	30/33
07	0	-	-	-	-	-	0	0	-	-	0	36/42
<i>Ephedra viridis</i>												
98	0	-	-	-	-	-	0	0	-	-	0	-/-
99	20	-	20	-	-	-	0	0	-	-	0	-/-
02	0	-	-	-	-	-	0	0	-	-	0	22/30
07	0	-	-	-	-	-	0	0	-	-	0	30/42
<i>Juniperus osteosperma</i>												
98	0	-	-	-	-	360	0	0	-	-	0	-/-
99	0	-	-	-	-	220	0	0	-	-	0	-/-
02	0	-	-	-	-	-	0	0	-	-	0	-/-
07	0	-	-	-	-	60	0	0	-	-	0	-/-
<i>Purshia tridentata</i>												
98	0	-	-	-	-	-	0	0	-	-	0	-/-
99	0	-	-	-	-	-	0	0	-	-	0	17/25
02	0	-	-	-	-	-	0	0	-	-	0	21/28
07	0	-	-	-	-	-	0	0	-	-	0	-/-

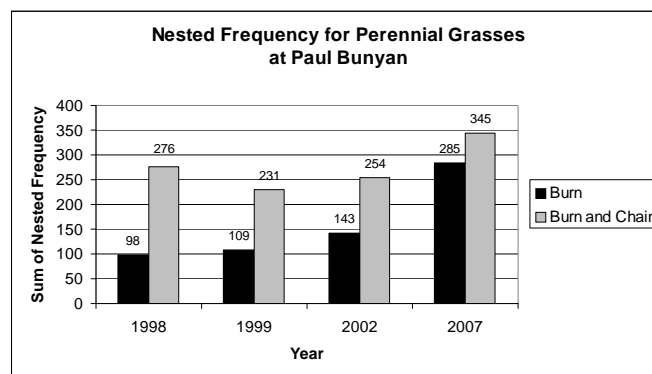
### Summary and Comparison of Paul Bunyan Burn (21A-19) and Paul Bunyan Burn and Chain (21A-20)

Studies 21A-19 and 21A-20 were established in 1998 to monitor the recovery of the vegetation community on two treatments following a wildfire. Both of these studies were aerially seeded, with study 21A-20 being chained one way with an Ely chain following the seeding. These studies were paired to compare differences in restoration efforts between seeding only (21A-19) and seeding followed by one-way chaining (21A-20) to cover the seed and enhance establishment of the seeded species. Both studies were seeded with the same mix.

The most important comparisons that can be made between these studies involve the establishment and persistence of the herbaceous species since the treatments. Grasses have developed into the major component of the vegetation community on both of these studies. During the initial reading in 1998 and in every sample year, perennial grasses were more abundant in average cover and sum of nested frequency on the chained study compared to the unchained study (Figures 1 and 2).



**Figure 1.** Average perennial grass cover on the Paul Bunyan fire rehabilitation studies, 1998-2007.

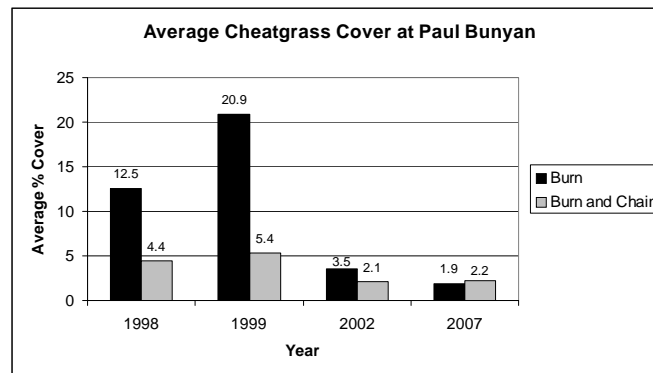


**Figure 2.** Nested frequency for perennial grasses on the Paul Bunyan fire rehabilitation studies, 1998-2007.

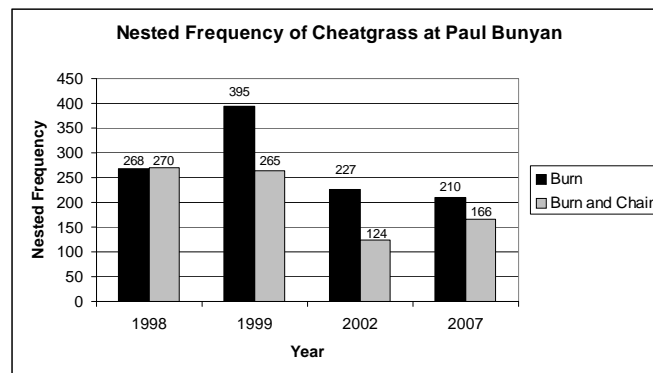
In the first sample year, perennial grasses provided more than three times the amount of cover on the study that was chained. Sum of nested frequency for all perennial grasses combined was nearly three times higher on the chained study as well. In 2007, 10 years after the treatments were conducted, perennial grasses still provided more cover and a higher sum of nested frequency on the study that was seeded and chained than the study that was only seeded.

Cheatgrass (*Bromus tectorum*) provided more cover on the unchained study in 1998, although nested frequency was nearly identical between the two treatments (Figures 3 and 4). In 1999 and 2002, cheatgrass

cover and nested frequency were higher on the unchained study. By 2007, average cover was similar between the two studies, although nested frequency remained higher on the unchained study.



**Figure 3.** Average cheatgrass cover on the Paul Bunyan fire rehabilitation studies, 1998-2007.



**Figure 4.** Nested frequency of cheatgrass on the Paul Bunyan fire rehabilitation studies, 1998-2007.

The best way to control cheatgrass competition is to establish a healthy and abundant perennial understory (Monsen 1994). The data from these studies are consistent with this concept. Perennial grasses, particularly seeded species, were more successful on the chained study, where the seedbed was prepared. On average, seeded grasses had higher quadrat frequency and cover values on the chained study each sample year after the treatment. Consequently, cheatgrass cover and nested frequency were lower on this study than on the unchained study in most sample years. Furthermore, on the unchained study, crested wheatgrass comprised 61% of the total grass cover by 2007, while the remaining seeded species, combined, comprised 17%. By the same year on the chained study, crested wheatgrass comprised 51% of the total grass cover, while the remaining seeded species comprised 35%. The higher seeding success on the chained study will increase the resilience of the community in the future.

Both the forb and browse components are sparse and relatively unimportant on these studies. Forbs were not included in the seed mix, due to the threat of noxious weed invasion and the possibility of herbicide application following treatment. The browse component was dominated by juniper (*Juniperus osteosperma*) prior to the burn, resulting in a depleted native seedbank of herbaceous and shrub species. Fourwing saltbush (*Atriplex canescens*) was seeded, but provided less than 1% cover on both studies in all sample years. Most of the vegetative community in 2007 continued to be composed of non-native seeded species. These studies have very little use for big game due to the minimal cover of palatable browse for winter forage.